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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/679,144

10/03/2003

Sanjeev Aggarwal

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TEXAS INSTRUMENTS INCORPORATED

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EXAMINER

KENNEDY, JENNIFER M

ART UNIT

PAPER NUMBER

2812

DATE MAILED: 09/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/679,144

Applicant(s)

AGGARWAL ET AL.

Examiner

Jennifer M. Kennedy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 74-76 and 80-97 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 74-76 and 80-97 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 74-76, 80-85, 87-91, 93-95, and 97 are rejected under 35 U.S.C. 102(e) as being anticipated by Basceri et al. (U.S. Patent No. 6,444,478).

In re claims 74 and 75, Basceri et al. discloses the PZT film prepared in accordance with the method comprising: forming a front-end structure over a semiconductor substrate (30, see explanation of substrate assembly, column 5, lines 32-45); forming a bottom electrode (32) over said front-end structure; preheating said semiconductor wafer (see column 7, lines 10 through column 8, lines 55); and forming a PZT film (see column 6, line 44 through column 7, line 5) over said bottom electrode; wherein said preheating step comprises heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas and an oxidizer gas (see column 8, lines 43-55 and column 9, lines 25-47, Pb being applied to example with Ti).

In re claim 76, Basceri et al. further discloses wherein the preheating step can be performed in a vacuum (see column 9, lines 15-25).

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In re claims 80-82, and 87-89, Basceri et al. discloses the PZT film formed wherein said preheating step comprises heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas of any one of He, Ar or N₂, and an oxidizer gas of any one of O₂, N₂O, and O₃ (see column 8, lines 43-55 and column 9, lines 25-47, Pb being applied to example with Ti).

In re claims 83-85, 90-91, 93-95, and 97, Basceri et al. also discloses wherein Ar comprises at least 20% (500 sccm) of the flow of inert/oxidizer gas mixture (where the oxidizer gas can be supplied anywhere from 1 to 5000 sccm), wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition, wherein the PZT film is PbZrO₃, wherein the PZT film is PbTiO₃, wherein the PZT film is a solid solution of the component end members PbZrO₃, and PbTiO₃ (see column 6, line 44 through column 7, line 5, Pb being applied to example with Ti).

While Basceri et al. does not specifically state the PZT film is PbZrO₃, the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Gilbert et al. disclosure of a Pb(Zr, Ti)O₃ (see column 1, line 1-5) film to read on the limitation of the PZT film being PbZrO₃ or PbTiO₃.

The examiner notes claims 74-76 and 80-97 are product-by-process claims. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product

itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” In re Thorpe, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

Claims 74-75, 80-82, 84-85, 87-91, and 93 are rejected under 35 U.S.C. 102(e) as being anticipated by Gilbert et al. (U.S. Patent No. 6,730,354).

Gilbert et al. discloses the PZT film prepared in accordance with the method comprising: forming a front-end structure over a semiconductor substrate (22), forming a bottom electrode over said front-end structure (see column 4, line 62 through column 5, line 5); preheating said semiconductor wafer containing said electronic device (bottom electrode), wherein said preheating step comprises heating said semiconductor wafer in an ambient comprised of a mixture of an inert gas of any one of He, Ar or N₂, and an oxidizer gas of any one of O₂, N₂O, and O₃, (see column 6, line 54 through column 7, line 13, and column 3, lines 13-55); and forming a PZT film (see column 7, lines 14-31 and column 2, lines 54-60) over said bottom electrode.

In re claims 84 and 90, Gilbert et al. disclose the device wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition of Pb_{1.0}(Zr,Ti)_{1.0}O₃ (see column 7, line 13 to column 8, line 6 and specifically Figure 5, wherein the preferred gas ratio Pb/ Zr +Ti of 1.00 to 1.07 shows a film containing a Pb/Zr +Ti ratio of approximately 1.1)

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In re claims 85, 91, and 93, Gilbert et al. disclose the device wherein said stoichiometric PZT film is PbZrO_3 , wherein said stoichiometric PZT film is PbTiO_3 , wherein said stoichiometric PZT film is a solid solution of the component end members PbZrO_3 and PbTiO_3 .

While Gilbert et al. does not specifically state the PZT film is either PbZrO_3 or PbTiO_3 , the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Gilbert et al. disclosure of a $\text{Pb}(\text{Zr}, \text{Ti})\text{O}_3$ (see column 1, line 1-5) film to read on the limitation of the PZT film being PbZrO_3 or PbTiO_3 .

The examiner notes that Merriam-Webster's Collegiate Dictionary, Tenth Edition defines solution as an act or the process by which a solid, liquid or gaseous substance is homogeneously mixed with a liquid or sometimes a gas or solid, or a homogeneous mixture formed by this process. The examiner notes that $\text{Pb}(\text{Zr}, \text{Ti})\text{O}_3$ is a solid solution of the component end members PbZrO_3 and PbTiO_3 .

The examiner notes claims 74-76 and 80-97 are product-by-process claims. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps. "[E]ven though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a

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different process." In re Thorpe, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 86, 92, and 96 are rejected under 35 U.S.C. 103(a) as being unpatentable over Basceri et al. (U.S. Patent No. 6,444,478).

Basceri et al. discloses the device substantially as claimed and rejected above, including having a La doped PZT film, but does not disclose the method wherein wherein the PZT film is doped up to 5%.

The examiner notes that Applicant does not teach that the dopant concentration range solves any stated problem or are for any particular purpose. Therefore, the dopant concentration range lacks criticality in the claimed invention and does not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to doped the PZT film with La up to 5%, since as Basceri et al. teaches the dopant concentration could be controlled in order to prevent degradation of the dielectric film and doping the PZT film is known to improve fatigue characteristics of the film, and because it has been held that where the

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general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233, MPEP 2144.05 II A.

Claim 83 is rejected 35 U.S.C. 103(a) as being unpatentable over Gilbert et al. (U.S. Patent No. 6,730,354).

Gilbert disclose the device as claimed and rejected above, but does not disclose the method wherein the Ar comprises at least 20% of the flow of the said inert/oxidizer gas.

The examiner notes that Applicant does not teach that the Ar flow rate of at least 20% solves any stated problem or is for any particular purpose. Therefore, the flow rate lacks criticality in the claimed invention and do not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the preheating step with an Ar flow rate at least 20%, since the invention would perform equally well to allow for a gradually heating of the substrate to prevent incidence of thermal shock which may cause the substrate to break and throughput to be minimized (see Gilbert et al., column 6, lines 54-65) and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233, MPEP 2144.05 II A.

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Claims 86 and 92 are rejected 35 U.S.C. 103(a) as being unpatentable over Gilbert et al. (U.S. Patent No. 6,730,354) in view of Sakurai (U.S. Patent No. 6,350,644).

Gilbert et al. disclose the device as claimed and rejected above, but does not disclose the method wherein the PZT film is doped up to 5% with either La or Nb. Sakurai discloses the method wherein the PZT film is doped up to 5% with either La or Nb (see column 4, lines 10-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to dope the PZT film as Sakurai discloses because doping with La or Nb is known in the art to improve fatigue characteristics and reduce leakage current.

Claims 76, and 95-97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakurai (U.S. Patent No. 6,350,644) in view of Isobe et al. (U.S. Patent No. 6,114,199)

In re claims 29 and 54, Sakurai discloses the PZT film prepared in accordance with the method comprising forming a bottom electrode over said a substrate (see column 2, line 65 through column 3, line 22 and column 7, lines 40-45); preheating said semiconductor wafer (column 7, lines 40-45), wherein said preheating step comprises heating said semiconductor wafer in a vacuum (see column 7, lines 40-45); and forming a PZT film (see column 7, lines 45-52) over said bottom electrode.

Sakurai discloses the device as claimed and rejected above including the method wherein the ferroelectric material is used in a DRAM or FRAM (see column 2, lines 20-

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23), but does not disclose the method wherein the bottom electrode is formed over a front-end structure. Isobe et al. discloses the device of forming transistors (12, 13) and then forming a bottom electrode (22) over the transistor, and therefore, a bottom electrode is disclosed as being formed over a front-end structure. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the bottom electrode over a front-end structure as Isobe et al. teaches, in the method of Sakurai, in order to drive current and provide an operable device.

In re claims 95 and 97, Sakurai disclose the device wherein said stoichiometric PZT film is PbZrO_3 , wherein said stoichiometric PZT film is PbTiO_3 , wherein said stoichiometric PZT film is a solid solution of the component end members PbZrO_3 and PbTiO_3 .

While Sakurai does not specifically state the PZT film is either PbZrO_3 or PbTiO_3 , the examiner notes that a PZT film must contain some titanium and some zirconium in order to be a PZT film (lead zirconium titanate) therefore, the examiner takes Sakurai disclosure of a $\text{Pb}(\text{Zr}, \text{Ti})\text{O}_3$ (see column 4, lines 4-20) film to read on the limitation of the PZT film being PbZrO_3 or PbTiO_3 .

The examiner notes that Merriam-Webster's Collegiate Dictionary, Tenth Edition defines solution as an act or the process by which a solid, liquid or gaseous substance is homogenously mixed with a liquid or sometimes a gas or solid, or a homogenous mixture formed by this process. The examiner notes that $\text{Pb}(\text{Zr}, \text{Ti})\text{O}_3$ is a solid solution of the component end members PbZrO_3 and PbTiO_3 .

In re claim 96, Sakurai disclose in one embodiment the device as claimed and rejected above, but do not disclose the device wherein the PZT film is doped up to 5% with either La or Nb. Sakurai discloses in another general embodiment the device wherein the PZT film is doped up to 5% with either La or Nb (see column 4, lines 10-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to dope the PZT film as Sakurai discloses because doping with La or Nb is known in the art to improve fatigue characteristics and reduce leakage current.

Claim 94 is rejected 35 U.S.C. 103(a) as being unpatentable over Sakurai (U.S. Patent No. 6,350,644) and Isobe et al. (U.S. Patent No. 6,114,199) in view of Gilbert et al. (U.S. Patent No. 6,730,354).

The combined Sakurai and Isobe et al. disclose the device as claimed and rejected above, but do not disclose the device wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition of $\text{Pb}_{1.0}(\text{Zr},\text{Ti})_{1.0}\text{O}_3$.

Gilbert et al. discloses the device wherein the PZT film contains at least 2% excess Pb from the stoichiometric composition of $\text{Pb}_{1.0}(\text{Zr},\text{Ti})_{1.0}\text{O}_3$ (see column 7, line 13 to column 8, line 6 and specifically Figure 5, wherein the preferred gas ratio Pb/ Zr +Ti of 1.00 to 1.07 shows a film containing a Pb/Zr +Ti ratio of approximately 1.1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a PZT layer of Sakurai with excess lead, because as Gilbert et al. teaches the material formed has excellent electrical properties.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Deso et al. (U.S. Patent No. 5,873,977) disclose that doping PZT with La and Nb is known in the art to improve fatigue characteristics and reduces leakage current.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Kennedy whose telephone number is (571) 272-1672. The examiner can normally be reached on Mon.-Fri. 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (571) 272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Jennifer M. Kennedy
Patent Examiner
Art Unit 2812